

## **ELECTRIC CONTROL FOR AUTOMOBILE HEADLIGHTS**

### **TECHNICAL FIELD OF THE INVENTION**

**[0001]** The present invention simplifies Adaptive Frontlighting Systems (AFS) for movable headlights for automobiles.

### **BACKGROUND OF THE INVENTION**

**[0002]** Currently AFS systems consist of sensors that typically detect steering angle, vehicle speed, and other parameters that feed signals into an electronic control unit (ECU). The ECU logic processes these signals and then sends the appropriate input into stepper motors that reposition the lighting units within the headlights. The primary objective of AFS is to cause the headlights to be aimed in the direction of travel in turning maneuvers and to be aimed properly in differing vehicle loading conditions. Prior art AFS typically use an ECU located in the trunk of the automobile. Prior art systems require a large amount of wiring needed to connect all of the sensors to the ECU. It would be desirable to move the ECU to the front of the automobile, eliminate the need for one or both of the steering and speed sensors, and reduce the amount of wires in the system.

### **BRIEF SUMMARY OF THE INVENTION**

**[0003]** The electric control for automobile headlights of this invention consists of an acceleration sensor that detects acceleration loads in two dimensions. The acceleration sensor of this invention includes a metallic ball surrounded by a viscous fluid encapsulated by a polycarbonate sphere. When the vehicle accelerates, either

in the longitudinal or lateral directions, a pressure transducer on the inside of the sphere will measure the pressure caused by the ball's motion against the wall of the sphere. Certain pressure levels corresponding to certain acceleration conditions will be processed by the ECU and cause the appropriate headlight movement. By sensing lateral accelerations, the acceleration sensor (or accelerometer) will replace the steering wheel sensor. This encapsulated ball system comprising the acceleration sensor will sit on top of the ECU behind the headlight system with wires connecting the sensor to the ECU.

**[0004]** A typical current design of AFS consists of steering, speed and instrument panel controls that feed input into an electronic unit. The ECU processes these signals and sends an input into stepper motors that adjust the position of the headlight units.

**[0005]** In accordance with this invention, the spherical capsule comprising the acceleration sensor sits on a polycarbonate tubular stand that is connected to an electronic control unit (ECU). This entire system is located behind the headlights of the car. Preferably, the height of the spherical capsule plus the tubular stand is approximately three inches. The friction between the ball and the fluid should be as low as possible, therefore the ball's surface coefficient of friction and the viscosity of this fluid should be low. When the vehicle accelerates forward, the sphere will push toward the rear wall of the sphere. When the vehicle turns, the sphere will push toward the side wall of the sphere.

**[0006]** Built into the walls of the polycarbonate sphere are two sensors. One sensor is located at the point of the sphere that faces the back of the vehicle. When the vehicle accelerates, this sensor will measure the pressure caused by the ball's

fore and aft (or longitudinal) motion against the wall of the sphere. Each level of pressure that is read by this sensor is proportional to the acceleration of the car that tend to cause the vehicle to pitch backward which causes a headlight aiming error unless compensated. These pressure readings are sent via wires to the ECU.

**[0007]** The ECU processes these signals and sends the appropriate signals to the stepper motors that control the headlight unit movement. This sensor replaces the steering wheel sensor found in a traditional AFS system. The other sensor in this invention is also built into the wall of the sphere capsule. When the vehicle turns, this sensor will read the position of the ball. Certain ball positions (corresponding to certain steering wheel positions) will be processed by the ECU and cause the appropriate headlight movement.

**[0008]** In light of the above, it is apparent that the AFS spherical sensor system of this invention enhances the early AFS system by placing the ECU closely behind the headlight to be controlled and requires fewer external inputs to operate. Furthermore, the large amount of wiring heretofore required is now not needed.

**[0009]** Other general and more specific aspects of this invention will be set forth in the ensuing description and claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]** FIGURE 1 is a perspective view of the AFS system of this invention showing the sensor of the device mounted on the electronical control unit (ECU);

**[0011]** FIGURE 2 is a sectional view of the sensor as seen from the lines 2-2 in FIGURE 1; and

**[0012]** FIGURE 3 is a side view of an automobile and the AFS mounted to the automobile.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0013]** The following description of the preferred embodiment of the invention is not intended to limit the scope of the invention that is described, but rather to enable a person skilled in the art to make and use the invention. Referring to the drawings, like reference numerals are used to designate like parts throughout.

**[0014]** Looking first at FIGURE 1, the AFS of the present invention is identified by reference number 11 and includes an electronical control unit (ECU) 10 mounted to the vehicle 12 in a position closely behind the headlight 14 of the vehicle 12. The spherical sensor system 15 consists of a metallic ball 16 surrounded by a viscous fluid 18 encapsulated by a polycarbonate sphere 20.

**[0015]** The friction between the ball 16 and the fluid 18 and the viscosity of the fluid 18 is very low. Built into the internal wall of the polycarbonate sphere 20 are two sensors 22 and 24. Sensors 22 and 24 detect pressure changes within sphere 20 exerted by viscous fluid 18. Pressure sensors 20 and 22 are located at 90 degree offset positions. Accordingly, any movement of ball 16 within sphere 20 causes associated pressure changes that can be either positive or negative pressure changes, depending on the direction of movement of the ball. It may further be possible to provide sensors 22 and 24 that are capable of measuring relative rotation between sphere 20 and ball 16. This provides another means for detecting turning of the vehicle since ball 16 will by its inertia tend to maintain stationary whereas the vehicle 12 and sphere 20 are rotated. Sensor 22 is located at the point of the ball 16 that faces the back of the sphere. This pressure sensor 24 may in many applications replace the speed sensor. Certain pressure levels will be

processed by the ECU and cause the appropriate headlight movement. When the vehicle turns, sensor 24 will read the position of the ball 16. The position sensor will replace the steering wheel sensor. Certain ball positions (corresponding to certain steering wheel positions) will be processed by the ECU and cause the appropriate headlight movement.

**[0016]** In addition to sensors 22 and 24 that measure pressure changes, other types of sensors could be used. For example, proximity type sensors or light wave based sensors could be used, so long as they are capable of detecting the movement of a mass such as ball 16. Moreover, it is further possible to use individual accelerometers to measure longitudinal and lateral accelerations. A simplified version of AFS 11 would measure only lateral accelerations, which could replace the need for a steering wheel angle input.

**[0017]** This encapsulated ball system will sit on top of the ECU 10 behind the headlight 14, with wire 26 (FIGURE 3) connecting the instrument panel 30 where the headlights are turned on and off. The ECU 10 processes signals from sensor system 15 and controls on the instrument panel 30 and sends an input into stepper motors (not shown) that adjust the position of the headlight units.

**[0018]** The wires 34 and 36 connect sensors 22 and 24 with the ECU 10, which signals the headlight 14 via the wiring 29.

**[0019]** It is pointed out that the sensor system 15 sits on the ECU 10. The height of the sensor system 15 plus the ECU 10 is approximately three inches. The friction between the ball 16 and the fluid 18 should be as low as possible. Therefore, the balls surface coefficient of friction and the viscosity of the fluid should be low.

**[0020]** The foregoing discussion discloses and describes a preferred embodiment of the invention. One skilled in the art will readily recognize from such discussion and from the accompanying drawings and claims that changes and modifications can be made to the invention without departing from the true spirit and fair scope of the invention as defined in the following claims. The invention has been described in an illustrative manner and it is to be understood that the terminology that has been used is intended to be in the nature of words and description rather than of limitation.